



# **CDR DEVELOPMENT PROJECT**

## **Database of vertical ozone profile measurements (BDBP)**

**Birgit Hassler, Karen H. Rosenlof  
NOAA Earth System Research Laboratory  
Chemical Sciences Division  
303-497-4182, [birgit.hassler@noaa.gov](mailto:birgit.hassler@noaa.gov)**

# BDBP – what is it?

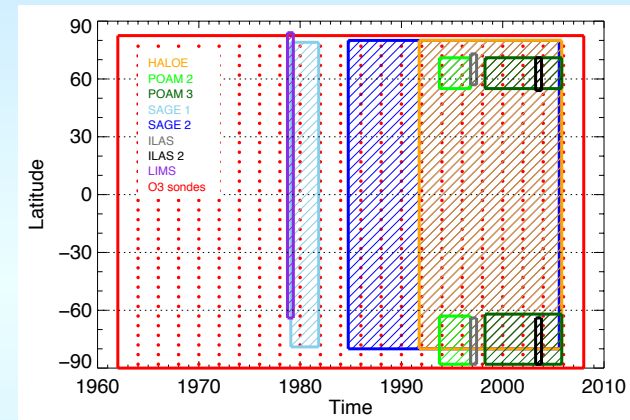
- BDBP – “*Binary Database of Profiles*” (produced with Greg Bodeker of Bodecker Scientific in New Zealand)
- Several different satellite-instruments and ozonesondes
- High resolution vertical profiles (so far mainly measurements by occultation instruments - solar or stellar - and ozonesondes)
- Individual measurements saved on pre-defined levels for pressure (70 levels), altitude (70 levels) and potential temperature (8 levels)
- Each profile is stored in each of the different database grids
- Ancillary data includes equivalent latitude
- Includes NO<sub>2</sub>, H<sub>2</sub>O, NO, CH<sub>4</sub>, HCl, HF and aerosol extinction (species relevant for stratospheric ozone chemistry).
- QC'd and percentage uncertainty estimates included
- Database is published, available by request (binary format)

# BDBP - zonal data set – what is it?

- Global, gap-free, zonal mean, monthly mean vertically resolved ozone data set (done with Greg Bodeker currently at Bodecker Scientific in New Zealand)
- January 1979 to December 2007
- Useful as boundary conditions for climate models that cannot calculate their own ozone fields
- 5° latitude bands, 70 vertical level (altitude or pressure), number density or mixing ratio
- BDBP data was used to calculate monthly means
- Data gaps were filled with multiple linear regression method
- Data set is published and publicly available as netCDF files.

# Project Description (1)

- Project Description: Combine measurements of primarily ozone from recent satellite missions. Time period will extend from the early 1980s to the present.



- Applications: Analysis of trends and variability, assessment of CCM simulations; ozone boundary conditions for global climate model simulations without interactive stratospheric chemistry; inferences on trends and variability in stratospheric transport.

# Project Description (2)

CDR(s)	Period of Record and Temporal Resolution	Spatial Resolution & Projection Used (if applicable)	Update Frequency	Data file distinction criteria	Inputs	Uncertainty Estimates (in percent or error)	Collateral Products (unofficial or unvalidated & produced alongside)
Binary Database of Profiles (BDBP)	mid 1960s – 2006 Individual measurements		randomly	Geographic location, time of measurement	Several different ground- and satellite-based measurement systems	Dependent on original measurement system	Other trace gas measurements beside ozone
BDBP global zonal mean, monthly mean ozone data set	01/1979 – 12/2007	5° lat bands	-	All in one file	Ozone monthly means Calculated from the BDBP	Not available	-

# Production Approach

- BDBP binary units have to be converted into netCDF files – no new calculation of the BDBP necessary for that
- BDBP zonal mean data set is available in netCDF already – no further conversion necessary
- Flexible format so that updates in the future (new satellite data, newer ozonesonde data) can be easily incorporated

# Validation & Quality Assurance

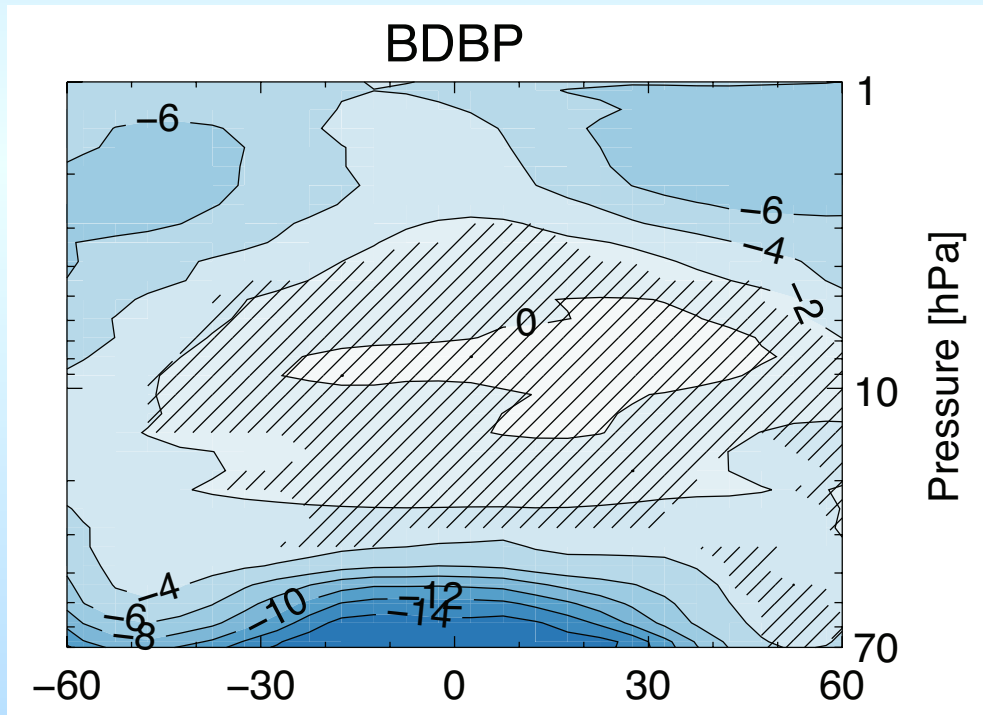
- Uncertainties for each individual measurement point (geographical location, altitude/pressure, time) is taken from original measurement system
- Assembly of data from different systems – only adjustment is the interpolation on common altitude/pressure levels
- BDBP global zonal mean, monthly mean data set is compared to different satellite measurements
  - Integrated profiles -> total column ozone measurements
  - Profiles -> individual measurement systems

# Uses & Applications

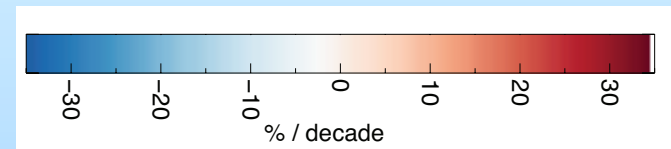
## 1) Determining stratospheric ozone trends

Key beneficiary: Health, Ecosystems

- Support of the 2014 WMO Ozone Assessment
- Participant in the SI2N Initiative (WMO)



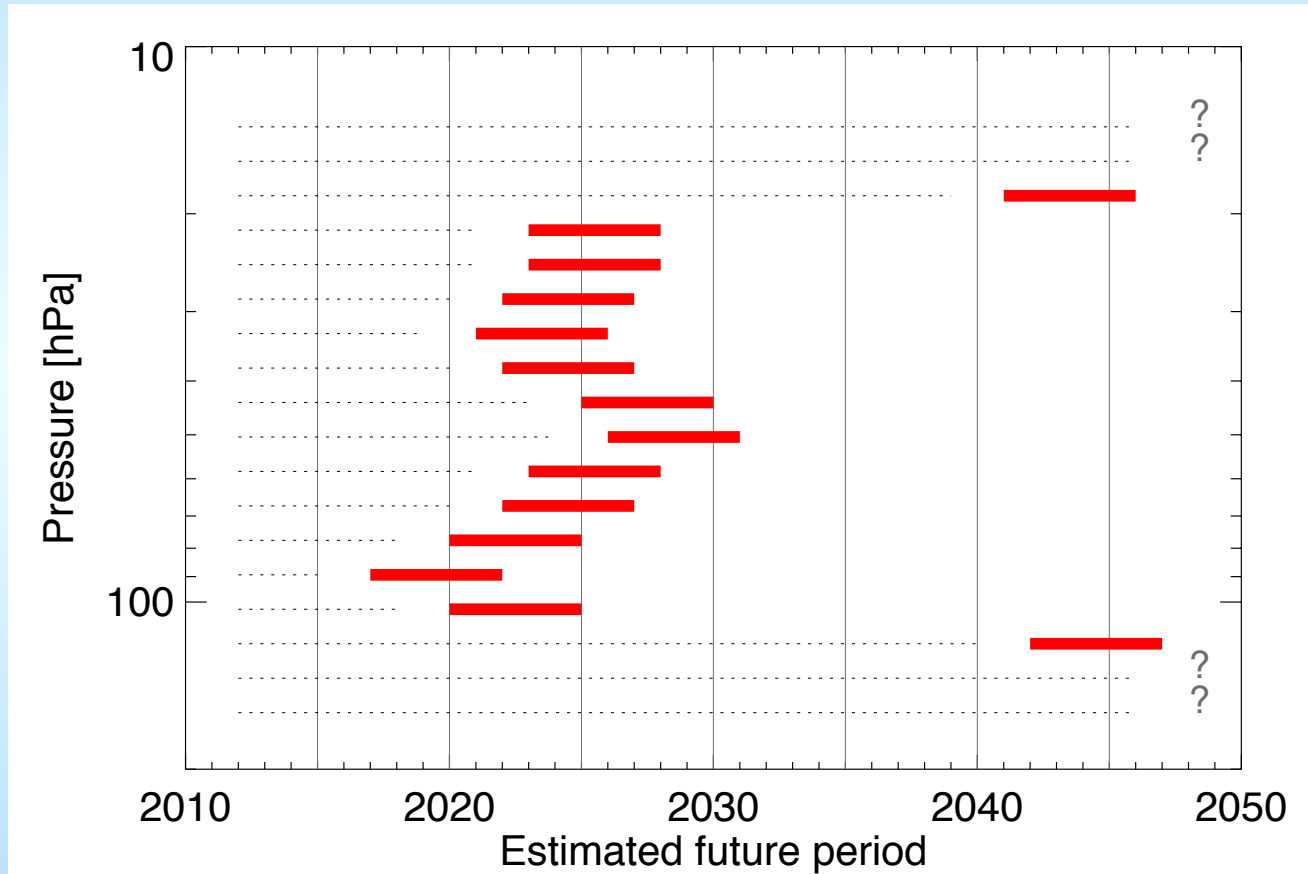
Annual mean trend [% per decade] as a function of latitude (60°S to 60°N) and pressure (70 hPa to 1 hPa) for the time period 1979 to 1996 for the BDBP dataset. Hatched regions show trends that are not significantly different from zero at the  $2\sigma$  level. Blue colours indicate negative trends, red colours indicate positive trends.





# Uses & Applications

## 2) Monitoring for ozone recovery Key beneficiary: Health



Estimated 5-year periods (red bars) in which differences between the peak loss rate profile and the future loss rate profile become significant.

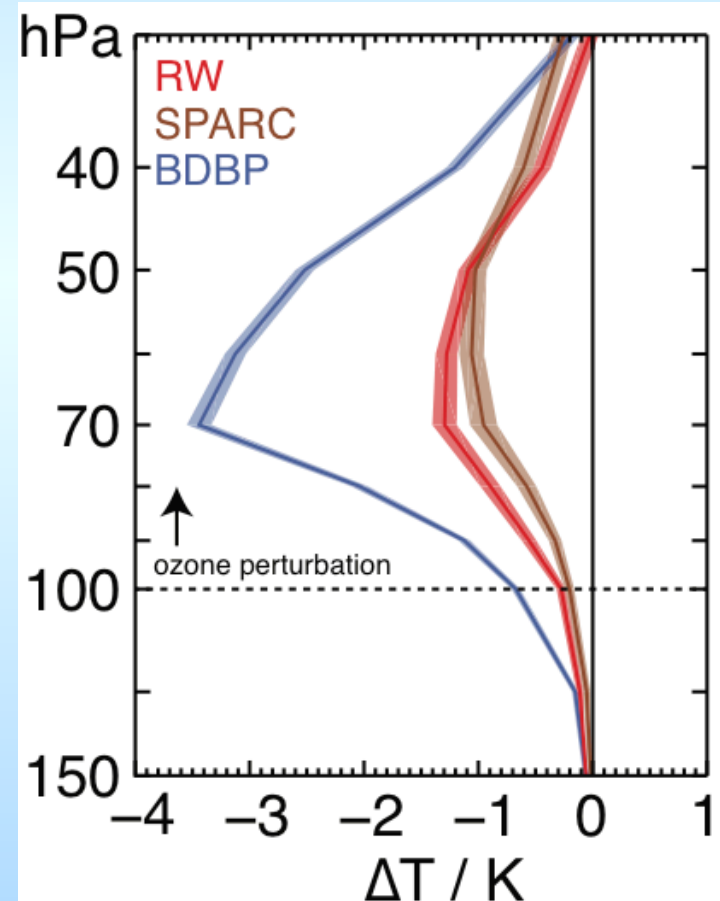
Hassler et al., JGR, 2011

# Uses & Applications

- 3) Modeling radiative processes including stratospheric temperature (that could potentially impacting surface temperatures and circulation)

## Key beneficiary: Ecosystems

Vertical profile of the change in model-calculated tropical average (20S–20N) annual mean temperatures for the lower stratosphere. The Figure shows the temperature change between three pairs of simulations, using 1979–81 and 1995–97 average ozone concentrations from each of the three ozone datasets. The shading about each line indicates the 95% confidence interval for the temperature change. The dotted line indicates the lower altitude limit for where the ozone was different in each simulation. Below this line, all simulations used a tropospheric ozone climatology.



Solomon et al., GRL, 2012

# Schedule & Issues

- Accomplishments over past year and project status
  - BDBP and BDBP zonal mean data set used for several published analyses
  - BDBP and BDBP zonal mean data set mentioned in NCAR's Climate Data Guide
- Milestones to finish development & testing:
  - BDBP and BDBP zonal mean data set are already publicly available on several sites, and published in several publications
  - Conversion of binary data files (BDBP) to netCDF files planned to be finished by beginning of 2014, BDBP zonal mean data set already available in netCDF
- State any risks or concerns
  - Since BDBP and BDBP zonal mean data set are both available already, the most critical point will be the conversion of the binary BDBP format into netCDF
- How can the CDR Program better assist you?
  - Help with creating the structure for the netCDF files of the BDBP

## **Publications about or using the BDBP:**

Evan et al., 2013, The representation of the TTL in a tropical channel version of the WRF model, JGR, doi:10.1002/jgrd.50288

Hassler et al., 2011, An assessment of changing ozone loss rates at South Pole: Twenty-five years of ozonesonde measurements, JGR, doi: 10.1029/2011JD016353

Karpechko et al., 2010, Quantitative assessment of Southern Hemisphere ozone in chemistry-climate model simulations, ACP, 10, Issue 3, 1385-1400.

Hassler et al., 2009, A vertically resolved, monthly mean, ozone database from 1979 to 2100 for constraining global climate model simulations, International Journal of Remote Sensing, doi: 10.1080/01431160902821874

Hassler et al., 2008, Technical Note: A new global database of trace gases and aerosols from multiple sources of high vertical resolution measurements, ACP, 8, Issue 17, 5403-5421.

## **Publications about or using the BDBP zonal mean data set:**

Hassler et al., 2013, Comparison of three vertically resolved ozone data bases: climatology, trends and radiative forcings, ACP, doi:10.5194/acp-13-5533-2013.

Bodeker et al., 2013, A vertically resolved, global, gap-free ozone database for assessing or constraining global climate model simulations, ESSD, doi:10.5194/essd-5-31-2013.

Solomon et al., 2012, Uncertainties in the evolution of stratospheric ozone and implications for recent temperature changes in the tropical lower stratosphere, GRL, doi:10.1029/2012GL052723.